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The Soviet Helicopter Industry: Development and Prospects

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An Intelligence Assessment

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December 1984

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An Intelligence Assessment

This paper was written by [redacted] Office of Soviet Analysis, and [redacted] Office of Scientific and Weapons Research. Comments and queries are welcome and may be addressed to the Chief, Defense Industries Division, SOVA, on [redacted]

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SOV 84-10205X
SW 84-10102X
December 1984

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The Soviet Helicopter Industry: Development and Prospects [redacted]

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Summary

Information available as of 27 November 1984 was used in this report.

Since its founding under great pressure from Stalin in the late 1940s, the Soviet helicopter industry has produced approximately 23,000 helicopters and overseen production of roughly 5,000 more in Poland. Nearly all of these helicopters were designed by the Mil or Kamov design bureaus, the latter occupying a small niche in the industry, mostly designing special-purpose helicopters for the Navy. Initially, the Soviets built most of their transport helicopters to move civilian personnel and equipment to remote areas of the USSR. Since the mid-1960s, however, military transport and attack applications have become dominant: the military received only about 25 percent of the helicopters produced in 1965, but by the early 1980s the military received approximately 90 percent. Three of the 17 helicopter models—the MI-2 light transport, the MI-8 medium transport, and the MI-24 attack helicopter—have accounted for roughly 60 percent of all Soviet helicopters produced over the last three decades. [redacted] 25X1

The Soviets have several helicopters which are in late stages of development and probably will satisfy their needs through much of the 1990s. These include:

- The Havoc, a Mil-designed attack helicopter and probably the first Soviet class to have a forward-looking infrared (FLIR) target acquisition system that should allow it to maneuver safely in bad weather and engage targets at night.
- The Hokum, a Kamov-designed attack helicopter whose configuration and performance suggest it may be used, at least in part, for air-to-air combat.
- The Sokol, designed jointly by Soviet and Polish engineers, as a light-to-medium replacement for the MI-4 transport helicopter.
- A medium transport [redacted] the Soviets are developing to supplement and eventually replace the 1960s-vintage MI-8. [redacted] this helicopter uses tilt-rotors, it will undoubtedly be able to fly substantially farther and faster than the MI-8. 25X1 25X1

Even though early Soviet scientists were pioneers of helicopter technology, analysis of these systems suggests that the USSR's helicopter industry now lags five to 10 years behind the United States'. [redacted] 25X1

In the 1990s the Soviet helicopter industry will concentrate on assimilating the production of basic helicopter models now in testing and on incorporating product improvements. As these new models are assimilated, we believe overall helicopter production will expand. Mil will probably continue to be the dominant design bureau, even though Kamov is demonstrating it can develop other helicopters, in addition to those for the Navy. [redacted]

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SOV 84-10205X
SW 84-10102X
December 1984

25X1

Soviet aircraft plants still emphasize labor-intensive methods and conventional materials, suggesting that assimilation of new helicopters incorporating more advanced technology and materials is likely to be a challenge. Therefore, producers are more likely than before to emphasize retooling instead of plant expansion to manufacture new models. If this occurs, construction at helicopter plants is less likely to be as reliable an indicator of new helicopter production as it has been in the past. 25X1

Helicopters being designed now for introduction in the 1990s will be based on early-to-mid-1980s technology. We have little information on how far Soviet helicopter technology has advanced since the Havoc and Hokum were conceived, but significant advances have been made in the United States during the past decade. We believe, therefore, that the five- to 10-year Soviet helicopter technology lag has not diminished appreciably. 25X1

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Contents

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The Soviet Helicopter Industry: Development and Prospects

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Development of the Industry

Russian scientists and engineers were leaders in the early development of helicopter technology. Russian writings reveal occasional research into the complexities of rotary-wing flight as early as the middle of the 18th century. Although basic research continued sporadically, Czarist governments frustrated engineering development of helicopters and other aircraft by resorting to Western suppliers of airframe components and engines for assembly in Russian factories. The only exception was Igor Sikorsky's St. Petersburg plant, dedicated to producing Russian-designed aircraft. Sikorsky emigrated to the United States in 1919 and subsequently formed the nucleus of the US helicopter industry.[1]

After the Russian revolution, increased support for aircraft development resulted in what the Soviets claim to be the world's first flight of a "true" helicopter in 1929. The helicopter prototype was assembled by a team that started work in 1925 at the Central Aerohydrodynamic Institute (TsAGI) in Moscow. By 1940, according to Western literature, TsAGI personnel had built and tested approximately 15 prototypes, but none of these were ordered into production.

Stalin's purges and the approach of World War II sidetracked helicopter development. In the late 1930s Stalin imprisoned many of the USSR's key aircraft designers—including several responsible for helicopter development. TsAGI also cut back helicopter design work to concentrate on development of fixed-wing aircraft, which were believed to afford a more immediate military application. After the institute's relocation to Novosibirsk, few helicopter prototypes were tested through the duration of the war. Even at the close of the war Stalin's efforts to exploit German know-how and equipment allegedly afforded little benefit to Soviet helicopter designers because fighters, bombers, and rockets received higher priority. By contrast, Igor Sikorsky built and tested the first US helicopter in 1939, and by the early 1940s the United States was mass-producing light reconnaissance and transport helicopters for the military.

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Possibly impressed by the rapid Western advances, the USSR moved quickly and forcefully to spur helicopter development. Near the end of the war, Stalin ordered a handful of key TsAGI designers to set up experimental design bureaus (OKBs). Although TsAGI continued to design helicopters through the late 1940s, OKBs headed by Alexander Yakovlev, Nikolai Kamov, and Mikhail Mil soon eclipsed the institute and formed the nucleus of the modern Soviet helicopter industry. Kamov's and Yakovlev's first known designs—respectively, the KA-8, popularly dubbed a flying motorcycle, and the YAK-100—were not serially produced. According to Soviet literature, Mil's first helicopter—the three-seat MI-1—was tested only nine months after Stalin ordered it developed in 1948, and it became the first Soviet helicopter to be produced in large numbers.

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Still dissatisfied in 1951, according to published Western sources, Stalin summoned the three helicopter designers to the Kremlin, accused them of ignoring the potential of the helicopter, and claimed that Soviet helicopter development had fallen too far behind that of the United States. The next day he ordered Mil to design a 12-passenger helicopter and Yakovlev to design a 24-seat craft—both within one year.

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virtually unlimited funds were allocated, personnel were increased severalfold, the workday extended from eight to 12 hours, and engineers and workers paid double wages. In touring the OKB's engineering spaces, after he was ordered to supervise the project, KGB chief Lavrentiy Beriya would ask what worker had distinguished himself and then hand the "innovator" a wad of bills on the spot. Under these conditions, the OKB completed the first preproduction prototype of the MI-4 medium transport helicopter in just seven months.

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The Mil OKB's success with the MI-4 established it as the leading Soviet helicopter design authority, a position it subsequently strengthened. In the mid-1950s, Yakovlev ceased helicopter development to

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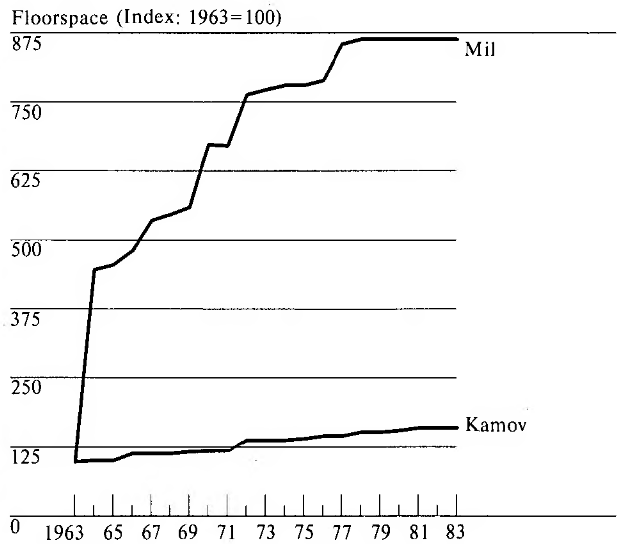
[1] According to open literature, Sikorsky built his first helicopter in Kiev in 1909, but he abandoned further development when he learned he would not be given additional support.

Mikhail Mil: Father of the Modern Soviet Helicopter Industry

Mikhail Mil graduated from the Novocherkassk Aviation Institute in 1931 and subsequently was employed in research on helicopter aerodynamics. In 1947, Stalin ordered him to become the chief designer of a newly created experimental design bureau for helicopters. Under his leadership, the bureau developed a greater variety of helicopters than either the Kamov or Yakovlev design bureaus, and Mil helicopters soon accounted for the majority of Soviet helicopter production. Mil was highly effective in mobilizing resources to meet program deadlines. [redacted] *Mikhail Mil is said to have coined this guidance for subordinates: "Make it simple, make it reliable, make it rugged, and make it work."* [redacted]

Figure 1
Growth of Research and Development Facilities At the Mil and Kamov Design Bureaus, 1963-83



[redacted] 25X1

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concentrate on fixed-wing aircraft. Kamov maintained efforts to offer a range of helicopters, but unsuccessful competition with Mil forced Kamov's retrenchment by the late 1950s into a small niche in the industry—mostly development of special-purpose coaxial helicopters for shipboard use.[2] Mil's success allegedly stemmed in part from his single-minded determination to meet customers' performance requirements and program deadlines, the classic characteristic of the conservative Soviet weapon designer (see inset, "Mikhail Mil: Father of the Modern Soviet Helicopter Industry"). The Mil OKB's dominance has persisted into the 1980s, after Mil's death and replacement by Marat Tischenko in 1970 and Kamov's death and replacement by Sergey Mikheyev in 1971. [redacted] since 1963, Mil facilities have grown at a rate unprecedented for Soviet design bureaus, while the Kamov facilities have stagnated (see figure 1). [redacted] 25X1

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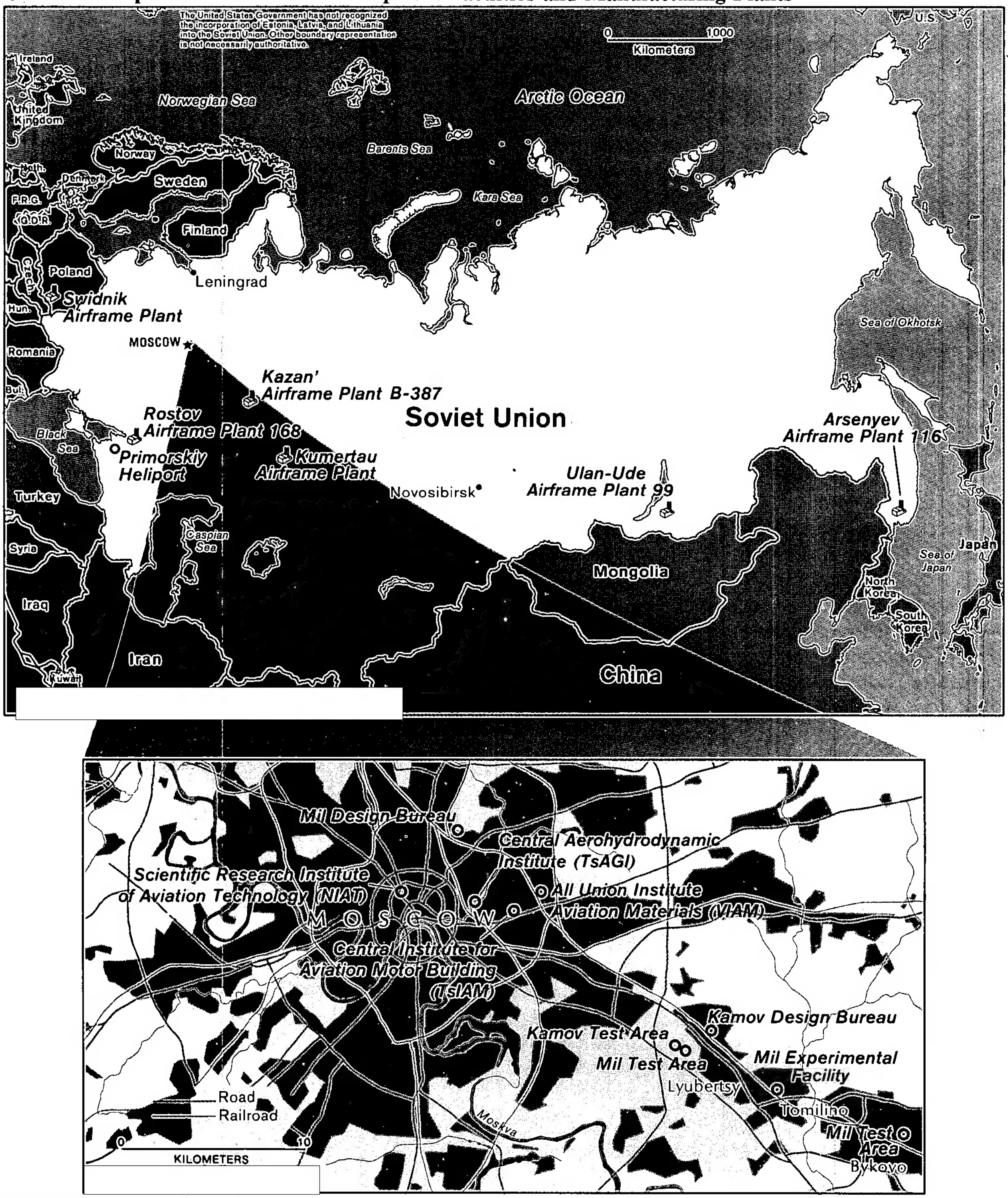
The Mil and Kamov design bureaus rely on a variety of R&D organizations to support helicopter development, most of them located in the Moscow area (see figure 2). Four leading aviation industry research institutes work on basic helicopter technologies: TsAGI on airframe design; the Central Institute for Aviation Motor Building (TsIAM) on small air-breathing engines; the All Union Institute for Aviation Materials (VIAM) on high-strength, lightweight

[2] Helicopters based on ships must be compact, to take up minimal flight deck and hangar space. The short tail boom without a tail rotor, a feature characteristic of the coaxial system, allows them to meet the space requirement. All but one of Kamov's helicopters that were serially produced have been used by the Soviet Navy. [redacted] 25X1

Figure 2
Soviet Helicopter Research and Development Facilities and Manufacturing Plants



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materials; and the Scientific Research Institute of Aviation Technology (NIAT) on manufacturing equipment and new production processes. Numerous design bureaus develop key subsystems, such as the Izotov and Soloviev bureaus for engines. Mil's own facilities are located on Rybinskaya Street (design), in Tomilino (assembly and test of prototypes), in Lyubertsy (tests), and in Bykovo (ground tests of propulsion and fuselage components). Kamov's facilities are located at Lyubertsy (design and assembly of prototypes) and the Primorskiy Heliport on the Black Sea (tests). Although probably more than 100 organizations participate in helicopter development, the Mil and Kamov bureaus—as general designers—are held responsible for ensuring that the final product meets the customers' performance specifications. [redacted]

Since the early 1950s the Mil and Kamov design bureaus, reflecting longstanding relationships common in the Soviet defense industry, have generally used different helicopter production facilities. Mil helicopters are produced at Ulan Ude Airframe Plant 99, Arsenyev Airframe Plant 116, Kazan Airframe Plant B-387, and Rostov Airframe Plant 168, the largest Soviet helicopter production plant. Kamov helicopters are produced at the Kumertau Airframe Plant, the smallest and newest Soviet helicopter plant. In 1963, helicopter plants accounted for roughly 10 percent of Soviet aircraft assembly floorspace. Since then, floorspace at Soviet helicopter plants has grown at about 4.6 percent per year, compared to about 1.9 percent for fighters and 2.7 percent for bombers and transports combined. As a result, the share of helicopter production floorspace in the Soviet aircraft industry rose to approximately 14 percent in the early 1980s.[3] [redacted]

The Transportation Equipment Works in Swidnik, Poland, also produces Mil-designed helicopters and has, in effect, become an adjunct to the Soviet helicopter industry. Manufacture of Soviet helicopters began in Poland during 1955, when some MI-1 light helicopter production was transferred from the USSR to Swidnik. This plant supplies all the light helicopters used by the Warsaw Pact (except Romania).[4] Maintaining the late-1950s-vintage MI-2 in production for

[redacted]

Soviet Control Over the Polish Helicopter Industry: The Swidnik Plant

The Polish Transportation Equipment Works, the only non-Soviet Warsaw Pact facility manufacturing a Soviet-designed helicopter, has been producing the MI-2 light helicopter for almost 20 years. [redacted] *the Soviets control production scheduling and the terms of sale:* 25X1 25X1 25X1

- *The USSR buys approximately 280 of the 300 MI-2s produced each year.*
- *The prices set by the Soviets do not cover Polish production costs.*

By relying on the increasingly antiquated Polish plant to supply their requirements for this simple system, the Soviets have been able to forgo MI-2 production and modernize their own plants for newer, more sophisticated helicopters. [redacted] 25X1 25X1

Inadequate investment in the Swidnik plant also strengthens the Soviet hand by frustrating Polish desires to earn hard currency by exporting helicopters. During the 1970s, the Poles wanted to export the MI-2, but it used too much fuel to be competitive in international markets. [redacted] 25X1 25X1 25X1

[4] Another East European plant, located in Bravsov, Romania, also builds helicopters. These helicopters—the Alouette III and Puma—were designed by the French firm Aerospatiale and are produced under license. The helicopters are deployed in the Romanian Air Force but are not exported to the USSR or any other Warsaw Pact member. [redacted] 25X1 25X1

so long has impaired modernization of the plant and has afforded the Soviets considerable control over plant operations (see inset, "Soviet Control Over the Polish Helicopter Industry: The Swidnik Plant").

Programs and Production

We have identified 23 major Soviet helicopter development programs since the late 1940s, all but two of them undertaken by the Mil or Kamov design bureaus. Seventeen of these helicopters were serially produced, usually in several variants, accounting for estimated cumulative production of about 23,000 Soviet helicopters. About 5,000 Soviet-designed light helicopters also were produced in Poland. Three of the 23 identified programs were canceled, but the pattern of design bureau activity and helicopter designators suggests that additional programs were commissioned and aborted before production, especially in the 1940s and 1950s. Figure 7 (a foldout) presents the helicopters, their mission, and our estimates of development and production periods and total production (see inset, "The Soviet Helicopter Development Process").

Development efforts in the 1950s concentrated on increasing carrying capacity and improving the operating efficiency of general purpose transport helicopters. The first generation of Mil, Kamov, and Yakovlev helicopters—the MI-1, MI-4, KA-8, KA-10, KA-15, KA-18, YAK-100, and YAK-24—all used piston engines. Total annual production of these piston-engine models rose throughout the decade, reaching an estimated 800 to 1,000 helicopters per year by the late 1950s.

Even as production of these systems grew, designers at Mil were applying turboshaft engine technology to the first of the next generation of helicopters, the heavy-lift MI-6, then the world's largest helicopter. Subsequent adaptation of the turboshaft engine to the light MI-2 and medium MI-8 helicopters afforded substantial improvement over their piston-engine predecessors in range, payload, and operating ceiling. The move to turboshaft engine technology also contributed to the 1950s restructuring of the Soviet helicopter industry. Kamov's first attempt with a turboshaft engine—the heavy-lift KA-22—lost out in a competition with the MI-6.

Figure 3
Soviet Helicopter Production, 1965-83

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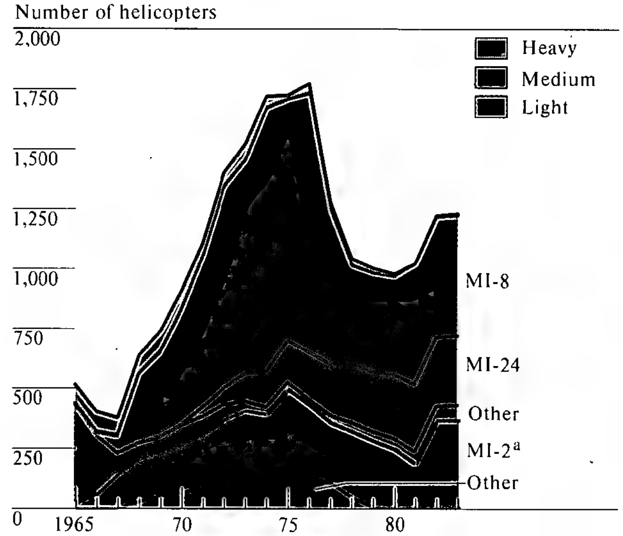

[a] Produced in Poland

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In the 1960s, helicopters became established in various civilian and military transport missions. Production of Mil's highly successful MI-2 and MI-8 accounted for much of the substantial growth of Soviet helicopter production through the 1960s and into the 1970s (see figure 3). The two helicopters account for roughly 50 percent of Soviet helicopters produced since the early 1950s. Aeroflot used the MI-8 extensively to transport passengers and freight to lightly populated outposts in Siberia and other remote areas. The MI-8 also figured prominently in supporting growing military emphasis on mobility in ground forces operations. 25X1

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In the 1960s, Mil and Kamov also were expanding the horizon of helicopter applications, pursuing development of systems for military ground attack and naval missions. Development of the MI-24 Hind, the Soviets' first multirole battlefield helicopter, was spurred

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The Soviet Helicopter Development Process

We estimate Soviet development periods by combining our analyses of fragmentary evidence on individual programs with our understanding of the Soviets' highly standardized development process. The process (see table) begins with the issue of a Tactical Technical Requirement (TTT) by the Ministry of Defense to the Ministry of the Aviation Industry (MAP). MAP in turn issues the TTT to the helicopter design bureau it believes to be most capable of successfully fulfilling the requirement. The TTT specifies the helicopter's intended role and desired performance characteristics.

The helicopter's design is elaborated through several stages:

- *The bureau prepares an Advanced Design, which outlines those TTT requirements that the bureau believes it can meet and illustrates the proposed general configuration of the helicopter. Subsequent negotiations culminate in a government decree and Technical Assignment (TZ), documents that officially authorize the development program and provide funding through flight-testing. The Technical Proposal provides additional detail governing agreed technical specifications.*

- *During Concept Design (*Eskizny Proyekt*)—translated as concept, preliminary, or draft design, the bureau undertakes or commissions design work on the fuselage, transmission, avionics, weapons, and engines and fabricates scale mockups of the helicopter and components. Designs and mockups are reviewed by the ministry, the customer, and a research institute.*

- *After official approval, solutions to any remaining engineering problems are worked out in Technical Design.*

- *Complete blueprints and material and production technology specifications are completed in Working Design.* 25X1

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Fabrication of helicopter prototypes consumes considerable resources. The first prototypes manufactured at an experimental plant undergo both static and flight-testing. If successful, additional helicopters are manufactured at the intended series production plant. Following state acceptance tests, the helicopter enters trial production. 25X1

When the Soviets commit a developmental helicopter to series production, they authorize the capital expansion and tooling necessary to assimilate the design into production. This usually occurs at the end of Technical Design. Expansion of a helicopter production facility therefore normally indicates that a new or substantially modified helicopter is scheduled to enter production. On average, construction of new floorspace at helicopter plants begins five to seven years before the start of series production. 25X1

in part by the effectiveness of US attack helicopters in Vietnam. Able to carry up to 28 troops as well as deliver weapons, the Hind set a number of speed records in the early 1970s and has been highly effective in Afghanistan. We estimate that about 2,600 MI-24s have been produced, roughly 10 percent of cumulative Soviet helicopter production. Kamov, in turn, concentrated on developing ship-based helicopters with coaxial-rotor systems. Kamov's major 1960s development—the KA-25 ASW helicopter—was not judged to be highly effective by Western analysts because of its limited range and sensor capabilities. 25X1

In the 1970s, Soviet helicopter designers undertook development of an array of new systems that incorporated significant advances in key subsystems. Probably as a result of growing sophistication and complexity, development time has increased from the six to seven years characteristic of the 1950s and 1960s to 10 or more years:

- The Mil bureau developed the MI-26 as a replacement for the MI-6, with considerable assistance

Soviet Helicopter Development Stages

Development Stage	Activity
Tactical Technical Requirement (TTT)	Ministry of Defense defines operational requirements for new helicopter
Advanced Design	Design bureau creates conceptual designs and illustrations
Technical Assignment (TZ)	Government and client authorize development program and funding through flight test
Technical Proposal	Bureau elaborates requirements not shown in TZ
Concept Design	Bureau documents basic design, commissions subsystem development, and builds full-scale mock-up
Technical Design	Design is elaborated and finalized
Working Design and Pilot Model Production	Bureau produces working drawings, fabricates prototypes, and completes static tests. Flight tests begin
Pilot Lot Production	Helicopter production plant manufactures prototypes for test
State Acceptance Tests	
Trial Production	Plant produces batch under serial production conditions

[redacted]

from acquired Western technology (see inset, "Impact of Western Technology: The MI-26 Halo").[5] [redacted] the Mil design bureau is routinely supplied with Western components and US design information, which benefit all Mil development work.) Other Mil helicopters, or Mil-inspired Polish helicopters, are still in development.

- The Kamov bureau developed the KA-27 ASW helicopter, a substantial improvement over the KA-25, and also has a system in development.

Production trends demonstrated the dominance of the Mil bureau, as it accounted for roughly 90 percent of

[5] The MI-26, with load-carrying capability one-third greater than that of the largest Western helicopter (the US CH-53E), has set new payload records. [redacted] 25X1

Impact of Western Technology: The MI-26 Halo

When the MI-26 was unveiled for the first time in the West at the June 1981 Paris Air Show, some analysts were intrigued by the main rotor gearbox. Generally, Soviet transmissions do not match the performance of Western designs because they are heavier—adversely affecting power-to-weight ratios. The new transmission in the MI-26, however, weighs about the same as the one in the MI-6, yet it transmits twice the power. Tischenko—leader of the Mil OKB—claimed that his bureau developed the gearbox indigenously. [redacted] 25X1 25X1 25X1 *development and production of the gearbox were greatly aided by Western technology.* [redacted] 25X1

In 1974, [redacted] *the Soviets bought computer software and capital equipment from a US firm for designing and building prototypes of the MI-26 transmission. The software sold to the Soviets enabled Mil to compute better estimates of gear engagements and stresses, as well as geometric surfaces and tooth profiles. Software was also provided that helped the bureau select and set up production tooling. In addition, the Soviets purchased one spiral bevel gear cutting machine that was installed in the prototype plant in Tomilino.* [redacted] 25X1 25X1 25X1

[redacted] *the Western technology was used to make spiral bevel gears for the main rotor, intermediate, and tail rotor gearboxes. Forward and aft right-angle reduction gears in the main gearbox are spiral bevels as well as several others in the tail shaft reduction system. The Tomilino plant also fabricated all of the other gears in these transmissions using equipment acquired from West German and Swiss companies.* [redacted] 25X1 25X1 25X1

Without the Western technology, [redacted] *Mil would have been unable to meet the minimum payload requirement specified by the Ministries of Defense and Aviation Industry.* [redacted] 25X1 25X1

all helicopters produced during 1965 to 1983. The number of military customers also grew, up from nearly 25 percent of the market in the mid-1960s to approximately 90 percent in the early 1980s. Overall, we estimate the Soviets have produced about 16,000 helicopters domestically since 1964, second only to US production of more than 20,000 over the same period.

Soviet helicopters now in production are relatively simple to manufacture, and long production runs afford major economies. Analysis of helicopters now deployed indicates that they would be about a third less expensive to manufacture in the United States than are Western designs for comparable missions.[6] This economy is a result of the Soviets' generally conservative design strategy and emphasis on incremental modernization and improvement between successive generations. We believe the more substantial advances incorporated in the systems now in development will drive costs up at a more rapid rate than the Soviets experienced with earlier helicopter advances. This would be in line with the major cost increases associated with the newest generation of fixed-wing aircraft.

Helicopters in Development

Three Soviet helicopters are in late stages of development—attack helicopters designated Havoc and Hokum by NATO and the Sokol W-3, a light-to-medium transport helicopter to be built in Poland. All are now undergoing flight tests, and we estimate that each should reach initial operational capability by the late 1980s. These systems, along with the MI-26 heavy-lift transport and KA-27 ASW helicopter that recently entered production, will fulfill all basic helicopter missions except for those of the medium-lift general purpose transport and light observation helicopter. However, analysis of system trends suggest that a follow-on to the 1960s-vintage medium MI-8 may be in the early stages of development, and Polish statements suggest that Swidnik also is developing a new light helicopter, possibly a follow-on to the MI-2. 25X1

The Havoc, Hokum, and W-3 incorporate technical advances over their predecessors in most of their major subsystems and should afford significantly improved performance in most respects. Most of the advances are in electronics and the application of advanced materials (including composites). Our analysis of these systems—especially the Havoc, for which we have the most information—suggests that Soviet helicopter technologies and designs lag US designs by five to 10 years. The systems in the mid-1970s incorporate technologies applied in US designs during the late 1960s (see inset, "The Soviet Lag in Helicopter Technology"). 25X1

Havoc. The Havoc, carrying the Soviet designator MI-28, is a dual-engine attack helicopter, probably equipped with a new target acquisition system but using a basically conventional airframe. Two Havoc prototypes with different target acquisition systems were first observed and photographed during flight tests (figure 4). As a dedicated attack helicopter, we believe the Havoc will augment but not totally replace the multirole Hind. 25X1

The Havoc's design, plus advances in key subsystems, should make it more capable in attack missions than the Hind. The absence of a cargo bay cuts size and weight, but the Soviets do not appear to have sought further reductions with extensive use of components made from composite materials.[7] The lighter weight Havoc, designed for agility, will enable crews to use low-flying tactics and terrain for cover and thereby improve firing accuracy and reduce detectability and vulnerability. 25X1

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The Soviet Lag in Helicopter Technology

We estimate the USSR lags the United States in helicopter technology—particularly in composite materials, small turboshaft engines, and advanced thermal-imaging equipment—by five to 10 years. We base this judgment on a comparison of these subsystem technologies incorporated in Soviet and US helicopters now in flight-testing. [redacted]

Composite airframe components have outstanding resistance to fatigue and have strength-to-weight ratios better than those of aluminum, steel, or titanium. [redacted] *An important exception is composite blade construction; the USSR is perfecting the capability to construct composite rotor blades with performance comparable to that of US blades.* [redacted]

Small, lightweight helicopter turboshaft engines are capable of higher turbine temperatures and pressure ratios, thereby increasing power and reducing fuel consumption. [redacted] *the USSR is developing these engines but is considerably behind the United States because of difficulty in manufacturing hot-section components, such as combustors and turbine blades, vanes, and disks. The Soviets—by their own admission—are nearly a decade behind in applying mass production technologies for some of these components.* [redacted] 25X1

Thermal-imaging devices used in target acquisition and night-vision systems permit helicopters to fly close to the ground and engage targets at night without artificial illumination. The USSR lacks adequate manufacturing technology to support large-scale production of silicon crystal components and solid-state electronics used in these devices. [redacted] *the USSR is expected to deploy a new forward-looking infrared (FLIR) system in the late 1980s, limiting the impact of the US lead.* [redacted]

The US lead in technology has not prevented the Soviets from deploying systems that equal US system performance in some characteristics—especially speed and payload. However, US advances in other characteristics provide clear advantages [redacted]

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The Havoc's target acquisition system represents its major technical advance. The Hind cannot fight effectively at night because it needs artificial illumination of targets with flares or floodlights. [redacted] The target acquisition system being tested on the Havoc A1 variant probably uses magnified direct-view optic equipment—as deployed on the Hind—or a low-light-level TV. On the basis of analysis of hand-held photography, we believe the system on the A2 variant is a FLIR. A FLIR on the Havoc would give it substantially improved night and bad weather capability over that demonstrated by the Hind. [redacted] 25X1

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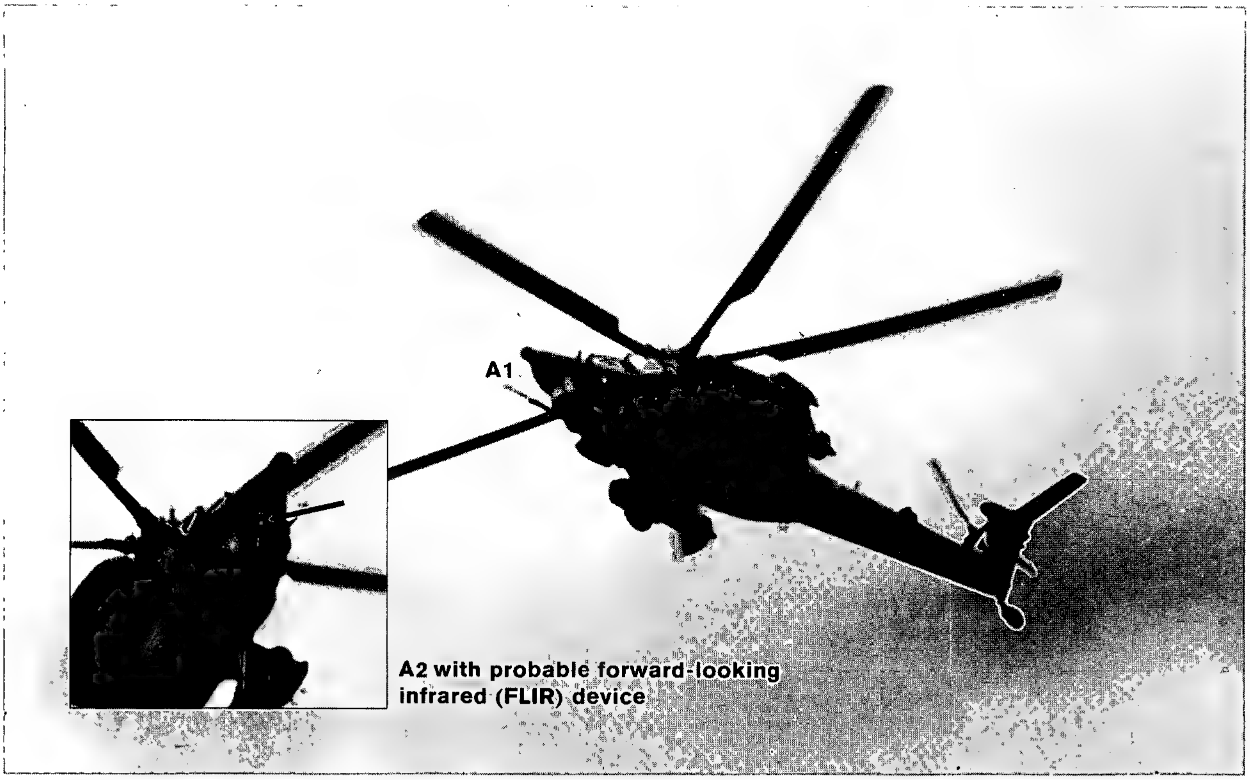

Figure 4. Havoc helicopters during flight-testing, Lyubertsy, [redacted] 25X1
[redacted] 25X1

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We believe that other Havoc advances will serve to increase survivability and operating efficiency:

- Vulnerability to enemy fire will be reduced by engine exhausts that appear to be designed to suppress emissions that draw heat-seeking missiles and possibly by the use of composites or higher strength materials in rotor blades. The metal blades of the MI-24 frequently collapse when hit once or twice by bursts from heavy machineguns. [redacted] the Moscow Scientific Research Institute of Light Alloys has been developing rotor blades using a range of composite materials since the early 1970s.

- Crew safety and helicopter survivability in a crash will be enhanced by a new trailing-arm landing gear. Conventional Soviet landing gears perform poorly on hard landings.

- Efficiency will be improved by the use of new engines, with a maximum power rating of 1,200 shaft horsepower (shp), [redacted] or 1,400 shp, according to Western performance assessments. In either case, evolutionary advances in engine technology, such as increasing compressor pressure ratios and higher turbine operating temperatures, probably have resulted in an engine that has lower specific fuel consumption and higher power-to-weight ratios than the TV3-117 engines used in the MI-24. [redacted]

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Advances in design and subsystem technology may have contributed to delays in the Havoc program. [redacted] development proceeded routinely from about 1975 until about 1980, when two prototypes were fabricated at Mil's Experimental 25X1

Figure 5. Hokum helicopter during flight-testing, Lyubertsy, [redacted] 25X1 25X1

Plant. The two prototypes encountered unknown difficulties that delayed the start of flight-testing. [redacted] the Havoc suffered from a serious structural weakness that required the bureau to redesign the lower fuselage. The problems apparently were resolved [redacted] when we identified [redacted] a prototype for static tests. Two months later, we identified a probable flight test prototype on the ground, [redacted]

Barring further delays, we believe the Havoc should reach initial operating capability by 1987. [redacted] we believe the Havoc will be produced at Arsenyev Airframe Plant 116. Production for the Ground and Air Forces is likely to continue through much of the 1990s. [redacted]

Hokum. The Hokum, carrying an unknown Soviet designator, is a dual-engine coaxial-rotor helicopter probably intended for an attack role. We first identified a Hokum in ground photography during a flight test in May 1983, and we later observed one in [redacted] the Kamov area of the Lyubertsy test center (see figure 5). The Soviets have built at least two prototypes. [redacted]

The Hokum may be capable of several missions, but evidence has mounted that its primary role will be as an attack helicopter: 25X1 25X1

[redacted] 25X1 25X1 25X1 25X1 25X1 25X1

- A camouflage paint scheme observed on a Hokum prototype suggests a role as a Ground Forces attack helicopter. 25X1 25X1

- In 1983, Mil-designed helicopters were being tested with tactical air-to-air and air-to-surface missiles at Primorskiy, heretofore associated only with Kamov helicopters. Testing may have been supporting weapons integration for a Kamov design. 25X1

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A naval version, either in an attack role or as an ASW platform, remains a possibility because of Kamov's longstanding relationship with naval aviation and because of the testing at Primorskiy. The Primorskiy testing with air-to-air missiles, along with a target acquisition system different from the Havoc's, suggests the Hokum may have a primary air engagement role as opposed to the Havoc's ground attack role (see inset, "Tactical Missiles for Soviet Helicopters,"

We believe the Hokum is comparable with the Havoc in technology, although we have almost no evidence on the Hokum's major subsystems. Because both entered development about the same time and because of aircraft industry practices, advances from indigenous research and technologies acquired from the West probably would have been available to both bureaus. Moreover, comparison of the bureaus' earlier helicopters that started development at about the same time demonstrates use of comparable material and manufacturing practices. the Hokum probably has a more advanced rotor design. Rotor blades swept at the tips reduce blade drag, noise, and vibration, and the probable use in each blade of at least one elastomeric bearing in place of conventional bearings improves

Tactical Missiles for Soviet Helicopters

The MI-24 Hind—the Soviet's most advanced operational attack helicopter—can engage aircraft using a nose-mounted Gatling gun and can attack ground targets with ATGMs, bombs, and rockets. In a dogfight, the weapon operator must use a Heads-Up-Display that shows an aiming circle for the gun corrected for crosswind, target motion, and bullet drop. In the case of a bomb run, the operator uses the display, determines bombsight settings, and operates a bomb release computer, while the pilot keeps the helicopter on course. Several missiles [redacted] *may enable Soviet helicopters to carry out attacks with more accurate and probably more easily launched air-to-air missiles (AAMs) and tactical air-to-surface missiles (TASMs).* [redacted]

The missiles, [redacted] *mounted on Hip and Hind helicopters, could be new designs or established models orginally developed for fighter aircraft. Existing Soviet AAMs and TASMs are independently guided by infrared, laser, or radar seekers—allowing the launching aircraft to react more quickly during combat. While the Soviets may use AAMs and TASMs on the Hip or Hind, they may also be used on the KA-27 Helix or the new Havoc or Hokum.* [redacted]

reliability and maintainability. The blades also probably are made of composite materials. Our performance estimates indicate that the Hokum will be faster than the Havoc and will have impressive maneuverability at high speeds. [redacted]

Like the Havoc, the Hokum program probably has taken longer than previous development efforts. We believe that development probably began in the mid-1970s, based on the likely availability of Kamov resources, freed at that time from work on the KA-27. [redacted] we believe the Hokum will reach operational capability about 1987. [redacted]

[redacted]

The Hokum's attack role, unusual for Kamov, along with its impressive performance, suggests that the bureau may be making a comeback under chief designer Sergey Mikheyev. Mikheyev's first effort, the KA-27 ASW helicopter, was judged by Western analysts to be a substantial improvement over its KA-25 predecessor. The Hokum's attack role indicates that the Kamov bureau may be broadening its customer base, expanding beyond the Navy to also service the numerically greater demands of the Ground or Air Forces. Direct competition between Mil and Kamov would be a departure from Soviet weapon development practices that have prevailed since the mid-1960s. [redacted]

W-3. The W-3—called the Sokol by the Warsaw Pact—is a light- to medium-weight transport helicopter developed at the Transportation Equipment Works in Swidnik, Poland. [redacted] Mil bureau engineers developed specifications for the W-3 in 1974 and oversaw subsequent development according to standard Soviet procedures. We believe the W-3 will replace the MI-4 helicopter, which was phased out of production in 1967. [redacted]

We think the technology incorporated in the W-3 will be similar to that incorporated in Western helicopters first deployed in the mid-1970s. The W-3's major technical advance is use of fiberglass-epoxy composites in the main rotor, tail rotor, and horizontal stabilizer. The W-3 will carry about the same payload as the MI-4, but weight savings and improved engine efficiency should give it a longer range. [redacted]

Deficiencies in Soviet support and Polish production technology have delayed W-3 series production. The W-3 has been undergoing flight-testing since 1979, longer than the Havoc or Hokum. [redacted] the Poles experienced difficulty in obtaining from the Soviets the parts and design assistance needed to fabricate prototypes. Shortcomings in Swidnik manufacturing facilities caused the

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composite rotor blades to be poorly constructed. In flight-testing, the main rotor blades tended to twist and eventually break off. [redacted] the problems with the composite blades were so serious that the W-3 may be initially certified with metal blades. [redacted]

If production technology difficulties have been resolved, the Sokol will probably be the first of the helicopters now in development to be deployed—probably in 1986. [redacted] the maximum production rate will be 300 a year, the same as for the MI-2. Like the MI-4, the W-3 is likely to be procured by all major Soviet military services and sold to selected arms clients. [redacted]

Probable Medium Transport. We believe the Soviets probably have a program under way to develop a follow-on to the widely used MI-8 medium transport helicopter. [redacted] Estimated annual production of the 1960s-vintage MI-8 at Kazan has declined since the mid-1970s, suggesting the Soviets plan to cut back the size of the MI-8 fleet and free a portion of the plant for retooling of a follow-on system. [redacted]

We have little firm evidence on the probable design or technical features of the next generation of medium transport helicopters [redacted]

[redacted]

- [redacted] a second tilt-rotor craft—designated the MI-32—was being designed and would be able to carry 30 troops.

The tilt-rotor concept combines the best performance features of the helicopter and the fixed-wing airplane: engines and prop-rotors are vertical in the helicopter mode of operation and are tilted forward in the airplane mode. Tilt-rotor craft demonstrate roughly twice the speed and ceiling and three times the range of a conventional helicopter using the same amount of fuel. [redacted]

We believe these efforts represent either authorized development programs or merely a research project to demonstrate the feasibility of the new tilt-rotor technology. [redacted] Further development would have required approval by a panel composed of representatives of the Ministry of the Aviation Industry, the military client, and other technical experts. We believe that most Soviet programs that are not selected for series production are terminated at this point. [redacted]

If the programs had been approved in the late 1970s, our experience of prior helicopter development suggests that flight-testing would have begun in the early 1980s. US analysts judge that tilt-rotor craft are within Soviet capabilities; but because the Soviets frequently use design inheritance, their responses to advanced technical challenges like tilt-rotor craft usually result in prolonged development cycles. Acquisition of mature Western tilt-rotor technology probably has a high priority. [redacted]

Prospects

We believe the more advanced helicopters recently deployed or now in late stages of development will meet the Soviets' basic helicopter requirements throughout the mid-1990s, enabling Mil and Kamov

to concentrate on upgrades and modifications. [redacted] Mil plans to develop a new attack helicopter different from the Havoc, a small piston-engine trainer, and a replacement for the MI-10—a version of the MI-6 that can accommodate especially wide or long cargoes. The Soviets are also likely to continue evolutionary improvements in other helicopters, such as the MI-8/MI-17 and the MI-24. [redacted] the Soviets may perceive requirements for improved lift capabilities, ranges, and weapon suites in these helicopters. Improvements could include composite blades or more advanced versions of the existing engines and weapons. [redacted]

Any new systems commissioned for development in the early 1980s would have been based on then current Soviet technology and will reach IOC in the early-to-mid-1990s. Since the Havoc—probably incorporating mid-1970s technology—the Soviets have continued research on major subsystems. [redacted] we judge it unlikely that they have appreciably closed the five- to 10-year lag in the application of advanced helicopter technology. [redacted]

The Soviets' problems in implementing more modest advances in the Havoc—for example, using composite materials—make it unlikely that they have since closed the technology gap. We believe systems reaching IOC in the 1990s will reflect largely evolutionary advances in technology. [redacted]

[redacted]

We believe helicopter production will increase over the next five years as the Havoc, Hokum, and other new or recently introduced systems are assimilated. The Mil and Kamov design bureaus also will continue to grow, but Mil will not sustain the explosive growth of the 1960s and 1970s. The relative standing of the bureaus is unlikely to change, although Kamov may be experiencing a resurgence and broadening of its customer base. We believe Soviet helicopter assembly capacity also will grow more slowly than in the past; of the new helicopters, only the Hokum is likely to be produced in substantially new facilities. In the industry as a whole, the Soviets will probably place greater emphasis on retooling existing production facilities. If this occurs, construction at helicopter plants is less likely to be as reliable an indicator of new helicopter production as it has been in the past. [redacted]

Series production is likely to be the greatest challenge. The Soviets are moving toward components that require close tolerances, need state-of-the-art materials processing and coating techniques, and use advanced testing equipment. Soviet plants—despite the Soviets' continued acquisition of Western technology—will remain deficient in precision-controlled machine tools and large quantities of sensitive testing equipment. Such deficiencies probably will make assimilation of future designs disruptive and difficult, continuing the pattern of the early 1980s. [redacted]

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